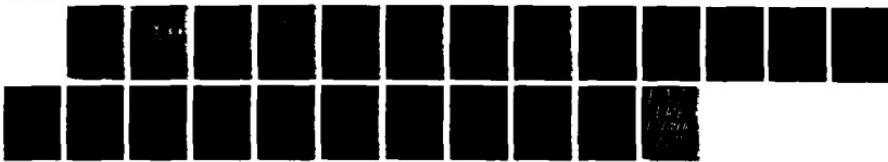


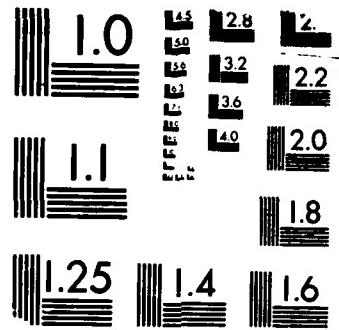
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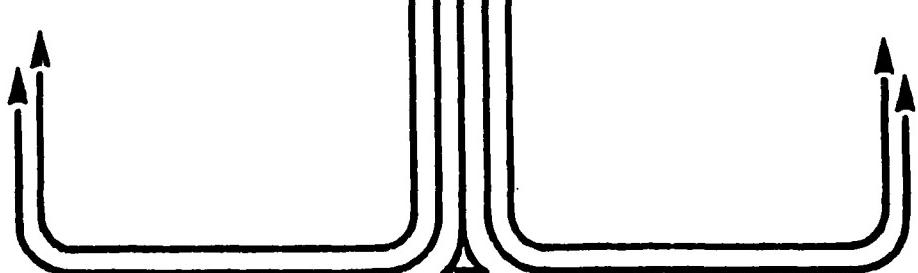
## STUDENT REPORT

QUALITY: THE ELUSIVE CHALLENGE

MAJOR TERENCE P. LONG

88-1605

"insights into tomorrow"



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## TABLE OF CONTENTS

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Preface.....	iii
About the Author.....	iv
INTRODUCTION.....	1
WHAT IS QUALITY?.....	1
IS DOD GETTING QUALITY?.....	2
QUALITY IS ELUSIVE.....	3
Commitment to Quality.....	4
Built-in Nonconformance.....	6
Free Market Forces.....	9
Optimize Product Designs and Manufacturing Process....	11
SUMMARY.....	12
BIBLIOGRAPHY.....	14

## INTRODUCTION

Every year the Department of Defense (DOD) spends billions to buy military hardware and software, and every year it spends billions more to fix what should have been done right the first time. In 1982, a DOD conference report estimated hidden factory costs--scrap, rework, and repair--at \$13.5 billion. (1:16) To some, this estimate may seem unreasonably high; however, even if it were only half that amount, the cost is still unacceptable. For example, this magnitude of waste equates to scrapping 33 B-1Bs (at \$220 million per copy) every year and represents an intolerable waste of precious defense dollars. Such waste, lack of quality, unnecessarily increases the cost of weapon systems and saps America of its military preparedness, readiness, and economic strength. What is quality? Is DOD getting the quality it wants? If not, why not? — → SF-73

## WHAT IS QUALITY?

Before addressing reasons why the DOD continues to receive substandard products, we must first establish an operational definition of "quality."

If one asks 100 people what quality is or what the term quality means, there are usually 100 different answers. For example, Webster's Dictionary defines quality as, "Any of the features that make something what it is; characteristic element,

attribute . . . the degree of excellence of what a thing possesses." Jeremy Main, in his article, "The Battle for Quality Begins," defines quality as "fitness for use, plus reliability delivered at a marketable price." (6:29) Philip Crosby, a highly respected author and consultant, defines quality as "conformance to requirements." (2:60, 64)

However the term is ultimately defined, it is the customer, DOD, who must communicate quality requirements and expectations. The government defines the requirements, and it is the contractor's responsibility to deliver products which conform to the requirements. Therefore, DOD must not only communicate quality requirements in the contract, it must enforce these requirements if they are not met by the contractor. Quality, then, is absolute conformance to contract requirements. Anything less is nonconformance, non-quality. This definition is strict but not unfair in view of the continuing reports concerning lack of quality in weapons and equipment the government purchases annually.

#### IS DOD GETTING QUALITY?

In November 1986, the General Accounting Office (GAO) issued a report concerning performance of the DOD's in-plant contract administration services (Defense Contract Administration Services, and Air Force, Army, and Navy Plant Representative Offices) and the quality of weapon systems being delivered. The report is condemning on two fronts. First, it states that

government oversight agencies are not doing their job and, most importantly, many contractors are not either.

We believe the present in-plant quality assurance program is not as effective as it should be in ensuring that quality products are delivered to field activities . . . many contractors are not adequately controlling and producing hardware which conforms with contract requirements. (13:1)

The Air Force COR [Contractor Operations Review] team concluded that 12 of 24 plants have less than satisfactory quality assurance functions. . . .

Product integrity was unacceptable in 13 of 24 plants. Discrepancies found 'included defective hardware, deficient work instructions, and failure to test the hardware in a manner that would duplicate end use.' (13:2)

Few need to be reminded of the horror stories surrounding the Maverick missile program or, more recently, the "60 Minutes" expose on the MX guidance systems which resulted in the temporary grounding of the Peacekeeper fleet. In these and similar cases, the American taxpayer is shortchanged and America's security jeopardized by the failure of the defense industrial complex and DOD's procurement system.

#### QUALITY IS ELUSIVE

The issues surrounding quality of DOD weapon systems are complex and not easily solvable. To better understand why DOD continues to get less than conformance to requirements, one should look at the following potential reasons: lack of total commitment to quality, defense versus non-defense market forces, building nonconformity into the contract, and failure to optimize product design and manufacturing processes before making production decisions.

## **Commitment to Quality?**

DOD's awareness of the need for quality improvement and its efforts to enhance the quality of delivered systems and subsystems has been ongoing for several years now. However, it may never realize the full potential of its initiatives unless DOD management from the top down becomes fully committed to adequately organizing, staffing, and recruiting individuals with the proper technical backgrounds.

For example, at Aeronautical Systems Division (ASD), the quality functions are performed by a subordinate part of the Contracting and Manufacturing Directorate. This organizational arrangement is a remnant of by-gone days when Manufacturing/Quality Assurance was a subdivision of the Contracting Directorate. These important but wholly different acquisition disciplines should be split apart, giving the Manufacturing and Quality Assurance communities greater and much needed respect, prestige, and influence throughout the acquisition process.

In addition to this organizational structure, I believe the quality function remains one of, if not the most, understaffed of the requisite acquisition disciplines. In 1987 ASD had over 1000 contracts (excluding research and development) associated with several hundred programs valued in the tens of billions of dollars. (5:--) The largest buying division in Air Force Systems Command had only 44 quality assurance specialists assigned to cover all pre-contract and post-contract requirements. According to the ASD Quality Assurance Division Chief, this great imbalance of programs to QA specialists results in "little time for

[effective] planning and lots of firefighting." (11:--) Additionally, there is a particular shortage of true quality engineers whose early involvement in the acquisition process would certainly reduce some of the problems DOD continues to experience today. Consequently, the government's reactive management approach to quality lacks the upfront planning and involvement by QA personnel to a level necessary to ensure DOD receives the best systems possible.

This staffing and experience problem exists not only at the buying divisions but also in the quality oversight agencies such as the Plant Representative Offices (PRO) and within the Defense Logistics Agency (DLA). A 1986 GAO report highlights the services' concern over not attracting and retaining qualified personnel, thus reducing the effectiveness of PRO operations. DLA, too, reports problems in hiring and retaining quality assurance specialists. (13:5,7)

According to the Director, high turnover and instability in the quality assurance work force has a direct, consequential effect on the acquisition of \$50 billion dollars worth of DOD products annually. (13:7)

The Army Materiel Command reports many of the interns hired do not have technical backgrounds or educations. (13:7) Apparently, QA personnel are being hired without the requisite skills and knowledge for the job. The quality assurance specialist must be familiar with and understand the manufacturing processes to produce the end product. Until DOD strengthens the link between its stated commitment to quality and the realities of its organization, staffing, and recruitment, it is unrealistic

to expect much more than what we are getting from contractors. Quality, like defense, requires constant vigilance and commitment.

#### Built-in Nonconformance

Another reason we continue to get products failing to conform to requirements is that we often allow and, in essence, encourage nonconformance--non-quality. An example of this is Military Standard 1520B, Corrective Action and Disposition System for Nonconforming Material (Mil-Std 1520B).

This particular Military Standard actually undermines the entire concept of quality by requiring the contractor to establish and maintain a very costly nonconformance management system. One of its requirements is to establish a material review board, composed of contractor personnel representing various disciplines, to investigate, document, and recommend disposition of any "item, part or product which departs from contract requirements, specifications, drawings, or other approved product description." (7:3,4)

A government survey of only 21 AF contractors indicated contractors and government representatives were processing over 370,000 material review board actions annually. (1:24) Both the government and contractors would be much better off if the millions of dollars associated with these actions were invested in resources to improve design and control of manufacturing processes. In the long run, Military Standard 1520B promotes delivery of nonconforming products at increased prices.

This system represents the typically American product oriented approach to quality--inspection after production. This is a reactive rather than preventive approach to quality assurance. Mr. L. P. Sullivan, manager of reliability and warranty (Body and Assembly Operation), Ford Motor Company, Dearborn, Michigan, feels this "reactionary quality approach manifested through problem-fixing is a guarantee against quality improvement. In other words, quality will not improve in companies that follow the defect-correction quality idea."

(12:78)

Publicly, DOD proclaims it wants systems conforming to contract requirements but contractually supports the use of non conforming materials and parts through the implementation of Mil-STD-1520B. Such a reactive system is doomed to failure.

Navy Commander Frank Vertovec's article, "Serious Manufacturing Deficiencies Versus the Delivery Schedule," unintentionally points out a lot of what is wrong with our procurement system. The entire article is based on the premise that the contractor is going to have a lot of nonconformances and, therefore, the government should develop corrective action plans and criteria for accepting nonconforming products. (1414-17) The underlying tone and assumptions of this viewpoint perpetuate the idea that a contractor cannot do the job right the first time and in order to meet or minimize delays which effect readiness, we must accept the situation. He writes:

Normally, a large manufacturer may have several thousand nonconforming circuit boards in various stages of production. It is in the best interest of the government

that criteria be established to salvage a good percentage of these nonconforming boards in order to continue production. (14:14-15)

If a contractor's quality is that bad, how did it ever win the contract? And I would argue that it is in the best interest of the government to severely penalize the contractor for shoddy workmanship.

The government should not be responsible for the tens of thousands of hours and hundreds of millions of dollars for reviewing, cataloging, and reworking defective materials because the contractor failed to control the manufacturing processes. If a contractor performs like this in peacetime, the performance could be disastrous in a wartime environment when schedules truly become critical. Recalls and warranties have no value on the battlefield.

Is it any wonder contractors continue to build and deliver nonconforming products when DOD seems to have that expectation of them; when required management systems emphasize the wrong approach to a problem; or when schedule is mistakenly put ahead of conformance to requirements in the name of readiness? In the long run, our readiness is reduced; we will continue to get nonconforming, inoperable products and we can never be sure of the consequences a nonconforming part or system will have. Quality compromise is a flirtation with disaster (Space Shuttle) and true national security interests. Prime contractors generally do not accept nonconforming goods from their suppliers. Why should the government?

Until DOD sends clear and consistent messages to all its contractors by not paying for and refusing to accept materials and systems failing to conform to contract requirements, contractors will continue to play the schedule versus quality game with an unpredictable impact on readiness. Where are the forces of the market place when they are needed?

### **Free Market Forces**

Unfortunately, free market forces have not assisted in improving the quality of America's defense products as they have begun to improve the quality and reliability of America's automobiles. When Detroit finally heard the complaints of US automobile consumers which had been reflected in its huge market share loss, it began doing something about quality. Labor practices were changed, factories were retooled, and statistical process control methods for monitoring quality were adopted.

(4:138) Survival of America's automobile industry depends upon its ability to respond to the free market's call for quality automobiles. Market pressures which knocked the automotive industry to its knees can do little to improve the quality of America's arms.

Competition in its truest sense plays a much less important role in defense acquisition because the defense sector of the US economy is a highly regulated industry characterized by a myriad of rules and regulations, laws, and legislative intervention. The Buy American Act protects this segment of the economy from intense foreign competition. The industry is characterized by

one buyer (the US government) and few competing sellers. The sellers are very much dependent upon the defense budget for their overall economic health. DOD is the specifier of new products, the banker, the regulator, the judge of claims and, with the exception of foreign military sales, the sole consumer. (3:5)

Because DOD cannot rely on defense market forces to improve quality, it could be better off if competition was based on overall quality instead of price or cost. Although the results are not in yet, the Defense Electronic Supply Center (DESC) has implemented a new way of doing business based on quality of the vendor's products. This new concept has moved away from price competition as being the sole element in selection for contract award. The new procedures allow officials to select a contractor with demonstrated quality and delivery capabilities even though his offer may be as much as 20 percent above the low bidder not qualified as a quality vendor. (10:17)

The government should require contractors to furnish audit-table costs of nonconformance. It should then use that information as a basis for future source selections. Conformance to present contracts and improvement over past requirements must play a larger role in the award process. Once a selection for production is made, the government should place the burden and responsibility for conformance on the contractor through the issuance of a fixed priced contract. It is a common belief that contractors will not accept such ambitious multi-billion dollar projects on a fixed price basis, but Rockwell did with the B-1B. To make fixed price contracts attractive to many contractors, the

decision to go into production must mean that all risks have been resolved or reduced to acceptable levels. With contractors sharing such a large portion of program responsibility, they will be highly motivated to "do it right the first time."

One of the reasons the defense industry has not suffered a fate worse than the automotive industry is because the US government would not let it happen. A strong domestic defense industry is an essential element of a nation's national power. However, if America must build arms for its own defense, they must be inexpensive enough to procure in adequate numbers and reliable enough to operate under battlefield conditions. Quality in design is the key to achieving both objectives.

#### **Optimize Product Designs and Manufacturing Processes**

Perhaps the most promising way to improve the quality of delivered systems is to optimize design and required manufacturing technologies before making full-scale production decisions. Design engineers must work more closely with manufacturing engineers throughout the entire design and production process. The Full Scale Development Phase should include demonstration of the manufacturing processes required to produce the system.

According to Juran and other experts, 80% of a product's defects are locked in by the design engineer. The remaining 20% are a result of defects introduced on the production line. (8:135) With such benefits to be gained in one area, isn't it reasonable to concentrate there?

Several military specifications require organizational liaison between a company's engineering and manufacturing departments. However, from the many program reviews I have participated in, the liaison seems to go barely deeper than the corporate organizational chart and internal operating procedures. It looks good on paper but, in reality, was not the corporate way of doing business.

The goals of this liaison are to design quality into products, and to design a defect-free product and process. This is preventive, not reactive, management. An example of what I am describing is known as the Taguchi method. It is an engineering design method that optimizes product design based on the manufacturing process and the ability to control the processes. It is a design program that desensitizes product design to process variations. The end result is a product designed to be robust enough to "achieve a high degree of quality despite fluctuation on the production line." (9:142) It is a design philosophy and process that consistently yields better products and cost savings.

#### SUMMARY

DOD is aware of the continuing problems in procuring products conforming to contract requirements. However, until it consistently holds the contractor responsible for conformance, and from the top down, and organizes, educates itself and staffs for effective implementation of quality requirements, quality will remain elusive. DOD's commitment and vigilance must be continuous, consistent, unwavering, and vocal. It must not

choose possible short-term benefits in schedule in place of quality with its benefits to long-term military readiness, weapons reliability, and force sustainability. We must recognize the failure of market forces to bring about improvement in product quality in the defense sector. A contractor's past product quality and conformance must be weighted more heavily during the source selection process as price competition has failed to bring about quality in defense products. Lastly, a product's design and manufacturing process must be optimized for quality. Engineering methods exist that offer such a process. How DOD responds to the elusive challenge will directly influence the future combat readiness and national security of the United States.

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